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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
TAI, XIUYU	
ART UNIT	PAPER NUMBER
1795	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/522,174	AWANO ET AL.	
	Examiner	Art Unit	
	Xiuyu Tai	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 October 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3 and 5-49* is/are pending in the application.

4a) Of the above claim(s) *14-39* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3, 5-13, and 40-49* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments with respect to claim1, 3, 5-13, and 40-49 have been considered but are moot in view of the new ground(s) of rejection necessitated by applicant's amendment.

2. In response to the argument that Hibino et al does not teach micro-region reaction sites, it should be noted that the boundaries between YSZ and cathode/anode electrode of Hibino have a metal phase of Pd electrode and some gap due to the presence of small particle grains. As defined by applicant, micro-region reaction sites have an interface containing metal phase, micro space and an oxygen deficient part. Although Hinibo is silent about an oxygen deficient layer, an oxygen-deficient layer is inherently formed at the boundaries of Pd electrode and YSZ from HIbino's method as is evident by the teaching of Arai (col. 4, line 55-65). Therefore, Hibino teaches micro-region reaction sites as claimed.

3. In response to applicant's argument that there is no suggestion to combine the references of Hibino and Chandran, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Hibino discloses an YSZ electrochemical reactor to reduce NOx while Chandran

discloses an electrochemical cell comprising YSZ and multiple cathodic electrode layers. Chandran indicates that multiple cathodic electrode layers can reduce voltage droop and is permeable to gas, hence improving reaction efficiency (paragraph [0010] &[0030]). Therefore, combining multiple cathodic electrode layers with the reactor of Hibino is within ordinary skill in the art. Furthermore, the references of Hibino and Chandran are analogous art because they are from the same filed of endeavor, namely electrochemical cell with YSZ. Moreover, the electrochemical cell of Chandran is also based on oxidation-reduction reaction (paragraph [0004] & [0005]) and it is fully capable of reducing NOx.

4. In response to the argument that the barrier layer of Diekmann is functionally different from the claimed barrier layer, it should be noted that the claimed barrier layer is "capable of interrupting electron conduction" as cited in claim 9 while the barrier layer of Diekmann is added to lower electric conductivity, ensuring enough electrical current between cathode and anode for electrochemical reaction (col. 2, line 5-12).It appears that the claimed barrier layer functions the same as that of Diekmann.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 41 and 47 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

7. Claim 41 recites the limitation "the oxidation phase" in line1. There is insufficient antecedent basis for this limitation in the claim. Appropriate correction is required.

8. Claim 47 recites the limitation "the reduction phase" in line1. There is insufficient antecedent basis for this limitation in the claim. Appropriate correction is required.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

11. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

12. Claims 1, 3, 5-8, 10-12, 40-43, and 45-48, are rejected under 35 U.S.C. 103(a) as being unpatentable over Hibino ("Medium-temperature electrolysis of NO and Ch4 under lean-burn conditions using Ytria-stabilized Zirconia as a Solid Electrolyte", J.CHEM. SOC. FARADAY TRANS., 91(13), 1955-1959, 1995) in evidence of Arai et al (U.S. 6,322,910) and further in view of Chandran et al (PG. Pub. U.S. 2002/0003085).

13. Regarding claim 1, Hibino et al disclose a single-compartment reactor. The reactor comprises: (1) a solid electrolyte YSZ as an oxygen ion conductor (Figure 1; page 1953); and (2) two Pd electrodes in the form of porous film as cathode and anode (Figure 1; page 1956). The reactions take place at cathode and anode depending on exhaust gases introduced into the reactor while a current is applied between cathode and anode (Figure 1; page 1955). The boundaries between YSZ and cathode/anode electrode have a metal phase of Pd electrode and some gap due to the presence of small particle grains. Hinibo is silent about an oxygen deficient layer. However, Arai et al disclose an organic electroluminescent device. Arai teaches that an oxygen-deficient layer is formed under oxygen-lacking condition (with no addition of oxygen, oxygen content of 60%-90%) while an oxide layer is formed under oxygen-rich environment (with the addition of oxygen, col. 4, line 55-65). Pd electrode of Hibino is attached to YSZ by electroless plating method in a mixed solution of 0.5% PdCl2 and 6% N2H4.2HCL at 90C (page 1956 of Hibino), which is under oxygen-lacking conditions (i.e. in an aqueous solution at higher temperature). Therefore, an oxygen-deficient layer

is inherently formed at the boundaries of Pd electrode and YSZ from HIbino's method as is evident by the teaching of Arai.

14. Hinibo fails to teach a working electrode layer on the upper part of the cathode. However, Chandran et al disclose an electrochemical cell for producing high oxygen concentration. The cell includes a plurality of cathodic layers 52 and 54 (Figure 3; paragraph [0030]). Chandran further indicates that the conductive porous layer 54 of platinum coated on the cathode 52 can reduce voltage droop and is permeable to gas, hence improving reaction efficiency (paragraph [0010] &[0030]). Therefore, it would be obvious for one having ordinary skill in the art to include another cathodic layer on the cathode as suggested by Chandran in order to improve electrochemical reaction efficiency of Hinibo.

15. Regarding claim 3, if only NO is introduced into the reactor, the reaction takes place at the cathode of Hibino (Figure 1; page 1955), reads on the instant claim.

16. Regarding claim 5, the reaction on the Pd cathode is the reduction of NO to N2 achieved by using YSZ as solid electrolyte (page 1955), reads on the instant claim.

17. Regarding claim 6, the reference of Hibino also teaches that as an alternative attachment method, Pd pastes with particle size less than 0.1 um were smeared on the left and right sides of electrolyte(page 1956), implying that electrodes contains small size particles, reads on the instant claim.

18. Regarding claim 7, as taught by Hibino, the boundaries between YSZ and cathode/anode electrode have a metal phase of Pd electrode and some gap due to the presence of small particle grains. Hinibo is silent about an oxygen deficient layer.

However, Arai et al disclose an organic electroluminescent device. Arai teaches that an oxygen-deficient layer is formed under oxygen-lacking condition (with no addition of oxygen, oxygen content of 60%-90%) while an oxide layer is formed under oxygen-rich environment (with the addition of oxygen, col. 4, line 55-65). Pd electrode of Hibino is attached to YSZ by electroless plating method in a mixed solution of 0.5% PdCl2 and 6% N2H4.2HCL at 90C (page 1956 of Hibino), which is under oxygen-lacking conditions (i.e. in an aqueous solution at higher temperature). Therefore, an oxygen-deficient layer is inherently formed at the boundaries of Pd electrode and YSZ from HIbino's method as is evident by the teaching of Arai.

19. Regarding claim 8, the single compartment reactor of Hibino has a structure that YSZ as an ion conductor contacts with Pd cathode and Pd anode (Figure 1; page 1956), reads on the instant claim.

20. Regarding claim 10, the reaction on the cathode of Hibino is the reduction of NO to N2 that is a conversion reaction of matter (NO to N2; page 1955; Figure 1), reads on the instant claim.

21. Regarding claim 11, the exhaust gas introduced into the cathode of Hibino is NO (Figure 1; page 1955), reads on the instant claim.

22. Regarding claim 12, the reaction on the cathode of Hibino is the reduction of NO to N2 (page 1955; Figure 1), reads on the instant claim.

23. Regarding claim 40, the solid electrolyte YSZ of Hibino is an oxygen ion conductor(Figure 1; page 1953), reads on the instant claim.

24. Regarding claims 41 and 47, Hibino teaches that reduction and oxidation reactions take place at the interface of two palladium electrode in the form of porous film (Figure 1; page 1955), reads on the instant claims.

25. Regarding claim 42, two Pd electrodes of Hibino (i.e. electrically conductive substance) in the form of porous film as cathode and anode (Figure 1; page 1956), reads on the instant claim.

26. Regarding claim 43, the solid electrolyte YSZ of Hibino is Ytria-stablized zirconia (i.e. zirconia stabilized with ytria), reads on the instant claim.

27. Regarding claim 45, Hibino carries out the experiment by electrolyzing NO (page 1956), reads on the instant claim.

28. Regarding claim 46, Hibino/Chandran is silent about the shape of the reactor. However, one having ordinary skill in the art would have realized to construct proper shape of the reactor in order to accommodate the intended use and/or user's preference.

29. Regarding claim 48, since the solid electrolyte is an oxygen ion conductor (Figure 1; page 1953), it is inherent to have the same characteristics as claimed.

30. Claims 9, 13, 44, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hibino and Chandran et al (PG. Pub. U.S. 2002/0003085) as applied to claim 1 above, and further in view of Diekmann et al (U.S. 6,268,076).

31. Regarding claim 9, Hinibo/Chandran fails to teach a barrier layer on the cathode. However, Dieckmann et al disclose a current collector for solid oxide full cell. The reference Diekmann states that a barrier layer is added to the cathode side to

vanishingly low electric conductivity, ensuring enough electrical current between cathode and anode for electrochemical reaction (col. 2, line 5-12). Therefore, it would be obvious for one having ordinary skill in the art to include a barrier layer as suggested by Dieckmann into the reactor of Hinibo/Chandran in order to ensure enough electrical current for electrochemical reaction to remove exhaust gases.

32. Regarding claim 13, since the barrier layer of Diekmann contains metallic alloy (col. 1, line 53-55) and Al2O3, a chemical reaction takes place as cited in the instant claim.

33. Regarding claim 44, since the barrier layer of Diekmann contains metallic alloy (col. 1, line 53-55) and Al2O3, reads on the instant claim.

34. Regarding claim 49, the solid electrolyte of Hibino is Ytria-stablized zirconia (comprising zirconia, ZrO2), reads on the instant claim.

Conclusion

35. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Xiuyu Tai whose telephone number is 571-270-1855. The examiner can normally be reached on Monday - Friday, 7:30 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/X. T./
Examiner, Art Unit 1795

/Alexa D. Neckel/
Supervisory Patent Examiner, Art Unit 1795